(19) World Intellectual Property Organization International Bureau



1 TERRI HALLER HALL

(43) International Publication Date 6 June 2002 (06.06.2002)

PCT

(10) International Publication Number WO 02/045156 A3

- (51) International Patent Classification?: H01L 21/8238, 27/092
- (21) International Application Number: PCT/US01/44162
- (22) International Filing Date:

6 November 2001 (06.11.2001)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data: 09/727,296

29 November 2000 (29.11.2000) US

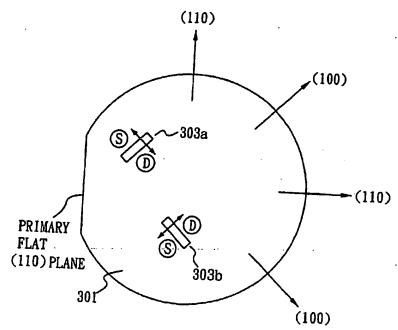
- (71) Applicant (for all designated States except US): INTEL CORPORATION [US/US]; 2200 Mission College Boulevard, Santa Clara, CA 95052 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): ARMSTRONG, Mark [US/US]; 2861 NW Adagio Way, Hillsboro, OR 97124 (US). SCHROM, Gerhard [US/US]; 7008 NE

Ronler Way, #3225, Hillsboro, CA 97124 (US). KUHN, Kelin, J. [US/US]; 20280 SW Clarion Street, Aloha, OR 97006 (US). PACKAN, Paul, A. [US/US]; 15025 SW Gibractar Court, Beaverton, OR 97007 (US). TYAGI, Sunit, D. [IN/US]; 17555 NW Waltuck Court, Portland, OR 97229 (US). THOMPSON, Scott, E. [US/US]; 18635 NW Rock Creek Way, Portland, OR 97229 (US).

- (74) Agents: MALLIE, Michael, J. et al.; Blakely, Sokoloff, Taylor & Zafman, 12400 Wilshire Boulevard, 7th Floor, Los Angeles, CA 90025 (US).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

(54) Title: CMOS FABRICATION PROCESS UTILIZING SPECIAL TRANSISTOR ORIENTATION



(57) Abstract: Complementary metal oxide semiconductor transistors are formed on a silicon substrate. The substrate has a {100} crystallographic orientation. The transistors are formed on the substrate so that current flows in the channels of the transistors are parallel to the <100> direction. Additionally, longitudinal tensile stress is applied to the channels.

patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

with international search report

(88) Date of publication of the international search report: 23 January 2003

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Intervacional Application No

		PORT	PCT/US 0	1/44162	
IPC	ASSIFICATION OF SUBJECT MATTER 7 H01L21/8238 H01L27/092				
Accordi	ing to international Patent Classification (IPC) or to both nationa	I elecalification and ma			
B. FIEL	LDS SEARCHED				
IPC	n documentation searched (classification system followed by cf $7 - H01L$	lassification symbols)			
1					
Docume	ntation searched other than minimum documentation to the exte	ent that such documents are inclu	derl in the fields o	nough a A	
ł					
Electronic	c data base consulted during the international search (name of	data base and, where practical, s	search terms used)	
EPO-I	nternal, PAJ, WPI Data, INSPEC, I	BM-TDB		,	
1					
-					
Category 6	MENTS CONSIDERED TO BE RELEVANT				\dashv
	Citation of document, with indication, where appropriate, of	the relevant passages		Relevant to claim No.	
Х	US 5 171 703 A (LIN YI-CHING	FT ALL		4.0.0	\dashv
1 '	15 December 1992 (1992-12-15)	LI AL)	[1,2,6, 10,11	1
	abstract; claims; figure 8 column 5, line 3 - line 8		1	,	
1	Column 9, line 48 - line 53				
	column 10, line 9 - line 11				
X	MATSUDA T ET AL: "ELECTRICAL CHARACTERISTICS OF			1,2,6,	
	0ø:/+-45ø:/90&osla	shORIEN		10,11	1
	INITON CHOOLEI MITHSOURCE/DRAT	N FARRICATED			
	BY VARIOUS ION-IMPLANTATION ME IEEE TRANSACTIONS ON ELECTRON	THODS" DEVICES			ı
	TEER INC. NEW YORK, US.	•			
	vol. 46, no. 4, April 1999 (199 pages 703-711, XP000906406	99-04),			1
•	ISSN: 0018-9383		ľ		
	abstract; figure 1				
		-/			
X Further	documents are listed in the continuation of box C.	V Patent family mant			┨
	garies of alted documents :	X Patent family memb	Ders are listed in ar	1nex.	ł
"A" document	defining the general state of the art which is not	"T" tater document published or priority date and not in	after the Internation	onal filing date]
901131041	coment but published on or after the international	invention	ancipie or theory	underlying the	
"L" document	which may throw doubts on priority claim(s) or	"X" document of particular rel cannot be considered no involve an inventive step			
	rother special reason (as specified) referring to an oral disclosure, use, exhibition or	'Y' document of particular rel cannot be considered to	evence: the eleime	of Investigation	
P document	Milhlished prior to the internetion to the	ments, such combination			
	are priority date classica	in the art. "&" document member of the	_		
Jake of the acti	al completion of the international search	Date of mailing of the Inte			
26	August 2002	30/08/2002		l	!
lame and maili	ing address of the ISA	Authorized officer			
	European Patent Office, P.B. 5816 Patentlaan 2 NL – 2280 HV Rijswijk	- wassing officer			
	Tel. (+31-70) 340-2040, Tx. 31 651 epo nl. Fax: (+31-70) 340-3016	Wirner, C			
n PCT/ISA/210 (s	second sheet) (July 1992)	<u> </u>	·		

Form PCT/ISA/210 (second sheet) (July 1992)

International Application No
PCT/US 01/44162

C./Continu	ation) DOCUMENTS CONSIDERED TO BE RELEVANT	PCT/US 01/44162	
Category •			
	or the relevant passages	Relevant to claim No.	
x	SAYAMA H ET AL: "EFFECT OF CHANNEL DIRECTION FOR HIGH PERFORMANCE SCE IMMUNE PMOSFET WITH LESS THAN 0.15MUM GATE LENGTH" INTERNATIONAL ELECTRON DEVICES MEETING 1999. IEDM. TECHNICAL DIGEST. WASHINGTON, DC, DEC. 5 - 8, 1999, NEW YORK, NY: IEEE, US, 1 August 2000 (2000-08-01), pages 657-660, XP000933266 ISBN: 0-7803-5411-7 the whole document	1,2,6, 10,11	
'	the whole document.	3-5,7-9,	
		12-15	
	WELSER J ET AL: "Strain dependence of the performance enhancement in strained-Sin-MOSFETs"	3,4,7,9, 12-14	
	ELECTRON DEVICES MEETING, 1994. TECHNICAL DIGEST., INTERNATIONAL SAN FRANCISCO, CA, USA 11-14 DEC. 1994, NEW YORK, NY, USA, IEEE,		
	11 December 1994 (1994-12-11), pages 373-376, XP010131874 ISBN: 0-7803-2111-1 abstract; figure 1		
į	page 373, left-hand column, paragraph 2		
·	SCOTT 6 ET AL: "Effect of stress and dopant redistribution on trench-isolated narrow devices" CHALLENGES IN PROCESS INTEGRATION AND DEVICE TECHNOLOGY, SANTA CLARA, CA, USA, 18-19 SEPT. 2000,	5,8,15	
	vol. 4181, pages 183-190, XP008006927 Proceedings of the SPIE - The International Society for Optical Engineering, 2000, SPIE-Int. Soc. Opt. Eng, USA ISSN: 0277-786X		
	abstract; table 1 page 186, paragraph 3 -page 187, paragraph		
	EP 0 703 628 A (MOTOROLA INC) 27 March 1996 (1996-03-27)	1,3,4,7, 9,10,	
	abstract; claims; figures	12-14	
-	-/		

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

International Application No
PCT/US 01/44162

C.(Continu	uation) DOCUMENTS CONSIDERED TO BE RELEVANT	PCT/US 01/44162
Category •	Citation of document, with indication, where appropriate, of the relevant passages	
 	passages	Relevant to ctalm No.
	SCOTT G ET AL: "NMOS drive current reduction caused by transistor layout and trench isolation induced stress" ELECTRON DEVICES MEETING, 1999. IEDM TECHNICAL DIGEST. INTERNATIONAL WASHINGTON, DC, USA 5-8 DEC. 1999, PISCATAWAY, NJ, USA, IEEE, US, 5 December 1999 (1999-12-05), pages 827-830, XP010372197 ISBN: 0-7803-5410-9 abstract	1,5,7,8, 10,12-15
A	US 6 046 494 A (CHAU ROBERT S ET AL) 4 April 2000 (2000-04-04) abstract; claims; figures	1,5,7,8, 10,12-15
	GB 1 222 251 A (THOMSON CSF) 10 February 1971 (1971-02-10) abstract; claims; figures	1,3,4,7, 9,10, 12-14
	page 1, line 54 -page 2, line 25 GB 928 562 A (WESTERN ELECTRIC CO) 12 June 1963 (1963-06-12)	1,3,4,7,
	abstract; claims; figures	9,10, 12-14
	PATENT ABSTRACTS OF JAPAN vol. 013, no. 435 (E-825), 28 September 1989 (1989-09-28) -& JP 01 162362 A (FUJITSU LTD), 26 June 1989 (1989-06-26) abstract; figures	1,2,6, 10,12
	auation of second sheet) (July 1992)	

page 3 of 3

information on patent family members

PCT/US 01/44162

Patent docu	mont	Dut the same			01/44162
cited in search	report	Publication date		Patent family member(s)	Publication date
US 51717	03 A	15-12-1992	JP	5198543 A	06-08-1993
EP 07036	28 A	27-03-1996	US	5561302 A	01-10-1996
			CN	1129358 A	21-08-1996
	•		EP	0703628 A2	27-03-1996
			JP	8111528 A	30-04-1996
	·		ມຣ	5683934 A	04-11-1997
US 604649	4. A	04-04-2000	US	5633202 A	27-05-1997
GB 122225	1 A	10-02-1971	FR	1522471 A	26-04-1968
			DE	1698122 A1	08-07-1971
			FR	2074759 A6	08-10-1971
	_		NL	6803482 A ,B,	16-09-1968
	·		US	3492861 A	03-02-1970
GB 928562	A	12-06-1963	BE	606275 A	C
			DE	1232270 B	12-01-1967
			FR	1295244 A	01-06-1962
	•	•	NL	267220 A	22 00 130E
·			U\$	3215568 A	02-11-1965
JP 0116236	2 A	26-06-1989	NONE		

Form PCT/ISA/210 (patent family annex) (July 1992)